

# PATENT SPECIFICATION

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## (54) LAMINATED ARTICLES AND METHOD OF MAKING SAME

(71) We, ADDRESSOGRAPH MUL-  
TIGRAPH CORPORATION, a corporation  
organised and existing under the laws of the  
State of Delaware, United States of America,  
of 20600 Chagrin Boulevard, Cleveland, State  
of Ohio, United States of America, do hereby  
declare the invention, for which we pray that  
a patent may be granted to us, and the method  
by which it is to be performed, to be particu-  
larly described in and by the following state-  
ment:—

This invention relates to the laminating  
art and more particularly to an improvement  
in laminated articles comprising a magnetic  
impulse record element secured to a vinyl  
plastics base.

For the purposes of this application, the  
term "vinyl plastics" is intended to define  
material in the form of sheets or films made  
from a resin consisting essentially of a  
homopolymer of vinyl chloride or a copolymer  
consisting of a major proportion of vinyl  
chloride and a minor proportion of vinyl  
acetate. Other ingredients conventionally  
present in vinyl plastics compositions such as  
fillers, colorants and stabilizers, may also be  
used.

The invention is particularly (but not  
exclusively) applicable to the manufacture of  
credit card blanks having a magnetic impulse  
record element, and will be described with  
particular reference thereto. However, it will  
be appreciated that the invention has much  
broader applicability and will find utility in  
the manufacture of any laminated article which  
comprises the combination of a vinyl plastics  
base with a magnetic impulse record element.

In recent years, the credit card industry has  
directed its attention toward increasing the  
usefulness of credit cards in terms of the  
quantity and type of information that can be  
carried on the cards. Of ancillary interest has  
been the capability of changing and updating  
information carried by the card without having  
to issue a new card. Still further, the not

insubstantial use of credit cards by unautho-  
rized persons has created a desire to include  
on the card, machine readable information  
which identifies the rightful owner of the  
card.

In furtherance of these goals, a considerable  
amount of effort has been expended in the  
development of a credit card combined with  
a magnetic impulse record element. As well  
known, such elements are capable of storing  
a considerable amount of machine readable  
information on a very small surface area, and  
the information so stored can be readily erased  
and updated repeatedly without adversely  
effecting the quality of the record.

One way of utilizing such a credit card  
is to record on its magnetic impulse record  
element, a money credit limit which the credit  
card issuer will honor. Thereafter, as the  
card is used in purchase transactions, the  
initial credit limit amount would be erased  
and supplanted with a lower money amount  
corresponding to the difference between the  
starting credit limit and the amount of the  
transaction. In the event that the last recorded  
credit limit is lower than the amount of the  
proposed transaction, the card would not be  
honored. When the card owner pays his bill,  
the reduced credit limit stored on his card is  
erased and replaced with a new starting credit  
limit.

The magnetic impulse record element could  
also be used to store information about the  
physical characteristics of the rightful card  
holder. In this way, when a merchant places  
the card in a suitably equipped transaction  
printer, he has an opportunity to read the  
physical characteristics of the card owner and  
visually check them against the card presenter  
to see if his characteristics match those on the  
card. Many other uses of a composite credit  
card and magnetic impulse record element  
will suggest themselves to those skilled in the  
art.

The early attempts to combine a credit

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card with a magnetic impulse record element involved nothing more than adhesively securing a strip of magnetic recording or computer tape to a credit card blank. This proved to be less than satisfactory because of delamination problems.

This difficulty has in some measure been overcome by transferring from the magnetic tape only the coating portion which comprises a dispersion of magnetic particles in a binder matrix. This is accomplished by a hot stamping technique such as that conventionally practiced in stamping titles and designs on book bindings, and monograms and initials on luggage.

Because the coating on the magnetic tape only is transferred from its carrier or backing strip to the credit card blank, the resulting magnetic impulse record element is much thinner than in the case where the magnetic tape is laminated to the credit card blank. This reduces the tendency of the record element to delaminate.

The hot stamping method for providing the credit card blank with a magnetic impulse record element suffers its own unique disadvantages. First, it produces a phenomenon which will be referred to as "cupping". This is characterized by a nonuniform concave curvature of the record element and the underlying area of the credit card blank. Cupping is believed to be caused by the flow of the vinyl plastic material, from which the credit card is formed, in response to the pressure of the heated platen of the hot stamping equipment. The adverse effect it produces is manifested in variations in signal strength across the width of the magnetic impulse record element. Recording and playback heads are set a fixed distance from the record element, and as the latter recedes from the fixed head in following the contour of the cupped credit card blank, there is a concomitant reduction in signal strength.

The wider the stripe of magnetic impulse record element, the more severe the cupping problem. Experimentation has shown that the amount of cupping which accompanies the transfer of a stripe 0.3 inches wide is tolerable although improvement would be desirable. The amount of cupping which accompanies the transfer of a stripe 0.58 inches wide exceeds 200 micro-inches per 0.1 inch of stripe width, and this exceeds the tolerance limits for at least the recorder head used in the experiment. In each case, the heat needed to transfer the magnetic material from its carrier to the credit card blank dictated that the hot stamping platen be maintained at a temperature in excess of 400°F.

The second disadvantage of the hot stamping method is that even at platen temperatures of 400°F and above, heat stamping directly from a magnetic tape to a credit card blank can produce as low as a 50% yield and lower

of satisfactory magnetic impulse record elements depending on the width of magnetic stripe transferred. The wider the stripe, the lower the yield. Defects range from small pinholes to large gaping areas caused by the coating on the magnetic tape being retained by its carrier and not transferred to the credit card blank. Because of the low yield and problems created by excessive "cupping", direct heat stamp transfer of the magnetic coating from a magnetic tape to a credit card blank is not deemed to be commercially practicable at least for stripes on the order of 0.5 inches and wider.

It is therefore apparent that there is need for an improved vinyl plastic member such as a credit card blank having a magnetic impulse record element and an improved method of making the same. The present invention is addressed to filling these needs.

The invention in one aspect provides a laminated article comprising a base of vinyl plastics as hereinbefore defined having a surface at least a portion of which is provided with a coating consisting of a dry residue of a partially hydrolyzed vinyl chloride-vinyl acetate copolymer comprising, on a solids basis, from 88 to 94 weight per cent polyvinyl chloride, from 2 to 6 weight percent polyvinyl acetate, and from 2 to 10 weight per cent polyvinyl alcohol and a magnetic impulse record element comprising a dispersion of magnetic particles in a binder matrix overlying and bonded to said coating.

In another aspect the invention provides a method of providing on a base of vinyl plastics as hereinbefore defined a magnetic impulse record element, comprising the steps of:—

forming on a backing strip a transferable magnetic impulse record element comprising a dispersion of magnetic particles in a binder matrix,

forming on at least a portion of the base, or on the magnetic impulse record element, a coating, which is adhesive when hot, and which consists of a dry residue of a partially hydrolyzed vinyl chloride-vinyl acetate copolymer comprising, on a solids basis, from 88 to 94 weight percent polyvinyl chloride, from 2 to 6 weight percent polyvinyl acetate, and from 20 to 10 weight per cent polyvinyl alcohol, and

transferring the magnetic impulse record element from the backing strip to the base by a hot stamping process, with the coating between the element and the base.

In preferred embodiments of the invention, a substantially lower stamping temperature can be used which in turn results in less severe "cupping" and yields in the 80 to 90% range even with stripes 0.5 inches wide and wider.

In the accompanying drawing:—

FIGURE 1 is a schematic, pictorial representation of a credit card blank having a magnetic impulse record element thereon;

FIGURE 2 is a schematic, sectional view taken generally along line 2—2 of FIGURE 1 with the proportions and dimensions greatly exaggerated for purposes of clarity; and,

FIGURE 3 is a schematic, sectional view similar to FIGURE 2, but showing a modified form of the invention.

Turning to the drawings, it will be seen that FIGURE 1 pictorially represents a credit card, designated generally as 10, to which has been applied magnetic impulse record element 12.

As best seen in FIGURE 2, credit card 10 comprises base 14 consisting of a rigid, but bendable vinyl plastics sheet, to which is laminated skin 16 which is an unplasticized vinyl plastics film. In the context of the present invention the vinyl plastics film is optional, but is included in the preferred embodiment because most credit cards are so constructed. The film protects the printed matter applied to the vinyl plastics sheet and provides the card with a smooth shiny surface.

Commercially available vinyl plastics sheet which may be used in the practice of the present invention include Emelux V265B—6 manufactured by Addressograph-Multigraph Corporation, Nixon 5193 manufactured by Nixon-Baldwin Division of Tenneco, Inc., and Union Carbide 3603 manufactured by Union Carbide Corporation.

Commercially available vinyl plastics film which may be used in the practice of the invention include Emelux V018A—1 manufactured by Addressograph-Multigraph Corporation, Nixon 1142 manufactured by Nixon-Baldwin Division of Tenneco, Inc., and Union Carbide 0411 and 0414 manufactured by Union Carbide Corporation.

Conventional sheet thicknesses will generally be in range of .01 inches to .03 inches, while conventional film thicknesses are in the range of 1 to 3 mils.

Referring again to FIGURE 2, it will be seen that there is interposed between magnetic impulse record element 12 and vinyl plastics film 16, coating 18 which consists of the dry residue of a composition containing polyvinyl chloride, polyvinyl acetate and polyvinyl alcohol produced by partial hydrolysis of a vinyl chloride-vinyl acetate copolymer. In this embodiment, coating 18 is generally coextensive in width and length with magnetic impulse record element 12. This can be accomplished by applying the coating to a localized area of credit card blank 10, or by applying it to the surface of the magnetic coating material prior to the hot stamp transference of the magnetic material to the surface of the credit card blank.

Referring to FIGURE 3, it will be seen that in this modified embodiment coating 18 covers the entire surface of credit card blank 10. In the practice of this embodiment, coating 18 may be applied either to the credit card

blank or to the vinyl plastic film, preferably the latter.

Coating 18 may be applied by any conventional coating method including spray, brush, or roller application. In practicing the embodiment illustrated in FIGURE 2, when the coating is applied to a localized portion of the surface of credit card blank 10, it is preferred to use a mask or screen to limit the area of application of the coating, but this is not essential. Use of a narrow brush or roller is also contemplated.

The "cupping" phenomenon described above is readily apparent from the drawings because the showing is greatly exaggerated. It will be appreciated, however, that as a practical matter, cupping provides only a slightly concave curvature to the exposed surface of magnetic impulse record elements, and to the underlying portions of coating 18, film 16 and sheet 14.

As noted above, magnetic impulse record element 12 may be formed of the magnetic coating composition used in magnetic recording and computer tapes.

In general, such magnetic coating compositions comprise a dispersion of magnetic particles in a binder matrix. In most conventional tapes, the magnetic ingredient in the coating composition consists of acicular (needle shaped) particles of gamma ferric oxide. These particles have lengths within the range of .2 to .8 microns, preferably .3 to .5 microns, and length to breadth ratios within the range of 2:1 to 8:1.

Other magnetic materials, although more costly, may also be used including cobalt doped gamma ferric oxide, chromium dioxide, acicular iron, cobalt or nickel particles, and cobalt-phosphorus, nickel-phosphorous and cobalt-nickel-phosphorus layers deposited by electroless or electrolytic methods.

The other major ingredient in the magnetic coating composition is a resin binder which may consist of one or more of a number of thermoplastic resinous binders including vinyl chloride-vinyl acetate copolymers, vinylidene chloride/acrylonitrile copolymers, butadiene/styrene rubber polymers, and polyurethane elastomers.

In addition to these ingredients, the magnetic coating compositions conventionally contain a conductive agent, mostly commonly the various forms of carbon black, which serves the purpose of controlling the conductivity of the composition to prevent build up of static charges; a dispersant, to assist in wetting out the magnetic particles, such as zinc naphthenate, dioctyl sodium sulfosuccinate the mono-, di- and tri-esters of oleic acid and triethanolamine. Other ingredients which may be included are stabilizers, lubricants and plasticizers.

The thickness of the coating of the magnetic composition on magnetic tapes is fairly well

standardized at 2.2 mils, 1.7 mils and 0.7 mils. Any of these may be used in the practice of the present invention.

The two most common carriers or supports for the magnetic composition, i.e. the tape itself, are films of cellulose acetate and polyester resins. Of these two classes of resins, the latter is the most popular, and most widely used polyester is polyethylene terephthalate. Much of this is sold under the DuPont trademark Mylar. The thickness of the carrier or backing strip is conventionally within the range of .0005 to .0015 inches.

Compositions containing polyvinyl chloride, polyvinyl acetate and polyvinyl alcohol produced by partial hydrolysis of a vinyl chloride-vinyl acetate copolymer, which may be used as coating 18, are commercially available. It has been found that very satisfactory results are achieved with compositions comprising on a solids basis, from 88 to 94 weight percent polyvinyl chloride, from 2 to 6 weight percent polyvinyl acetate, and from 2 to 10 weight percent polyvinyl alcohol.

A suitable commercial composition falling within this range of proportions is sold by Union Carbide Corporation under the designation, VAGH. This material, described by its manufacturer as a partially hydrolyzed, vinyl chloride-vinyl acetate copolymer, is believed to contain about 91 weight percent vinyl chloride, about 3 weight percent vinyl acetate and about 6 weight percent vinyl alcohol, on a solids basis.

To be useful in the preferred practice of the invention the partially hydrolyzed copolymer should be diluted with a suitable solvent to provide a coating composition containing from 5 to 18 weight percent solids. Compositions containing about 7 weight percent solids are particularly satisfactory.

The particular solvent employed should be selected so that in the time it takes for evaporation, it will not have any substantial detrimental effect on the vinyl plastics film or vinyl plastics sheet. Further, the solvent should evaporate within a reasonable period of time at temperature not exceeding about 150°F lest distortion of the substrate occur during drying of the coating. Suitable commercially available solvents include ethyleneglycol monoethyl ether, and ethyleneglycol monomethyl ether, both sold by Union Carbide Corporation under the trademarks Cellosolve and Methyl Cellosolve, respectively. Coating thicknesses within the range of 0.01 to 0.03 mils will produce satisfactory results. In general, coatings thicker than 0.03 mils may be used, but

are difficult to justify economically because they produce no further improvement in results.

The efficacy of the invention was confirmed by a series of experimental runs in which magnetic impulse record elements of .58 inches wide were formed on large numbers of credit card blanks by a hot stamping transfer method.

In all the runs, the same card stock was employed and the magnetic coating was transferred from the same magnetic recording tape stock (manufactured by 3M Corporation under the designation MTA 20730). Further, the same hot stamping equipment was employed with the ram force and dwell time being held constant throughout. The platen temperature was adjusted, however, for reasons explained below.

In four of the seven runs reported below, coating 18 was omitted, while it was included in the remaining three runs.

The hot stamping operation was conducted on a 8100 special model machine manufactured by Franklin Manufacturing Company. The machine feeds a credit card blank to a hot stamp work station and indexes a length of magnetic recording tape across the portion of the blank at the work station to which the magnetic coating on the tape is to be transferred. The tape is disposed with the carrier or support portion facing away from the credit card blank so that the magnetic coating on the tape is in juxtaposition with the credit card blank. The hot stamping platen, preheated to a set temperature, is lowered under a ram force and maintained in contact with the carrier side of the magnetic recording tape for a preset dwell time.

The credit card blank used throughout the test runs was formed of a vinyl plastics sheet .0625 inches thick manufactured by Addressograph-Multigraph Corporation and sold under the designation Emelux V265B-6. To each surface of the sheet was laminated a vinyl plastics film 1.8 mils thick manufactured by Addressograph-Multigraph Corporation and sold under the designation Emelux V018A-1.

A coating of Union Carbide Corporation partially hydrolyzed copolymer VAGH in a solvent was applied to one surface of the vinyl plastics films, prior to lamination to the vinyl plastics sheet, providing a dry coating having an average thickness of .02 mils.

The platen temperatures, dwell time and ram force at which the hot stamping machine was operated are set forth in the table below, together with the cupping values and yield percent for each run.

RUN #	NO. OF CARDS	PARTIALLY HYDROLYZED COPOLYMER COATING	PLATEN TEMP. (°F)	DWELL TIME (Milliseconds)	RAM FORCE (Tons)	CUPPING Micro Inch/ 0.1 Inch Strip Width	YIELD (%)
1	410	No	410	80	8	230	41
2	380	No	410	80	8	225	12
3	440	No	410	80	8	265	13
4	480	Yes	330	80	8	95	80
5	490	Yes	340	80	8	185	89
6	480	Yes	330	80	8	170	88
7	550	No	330	80	8	-	0

Cupping values were arrived at by readout of an amplified electrical signal generated by a commercially available instrument manufactured by Federal Products Corporation and sold under the name Federal Electronic Gage, which is comprised of a gauging head which measures distortions in the profile of the magnetic impulse record element while moving perpendicular to the longitudinal axis thereof. The yield values were arrived at by calculation based on a visual inspection of every credit card blank in each run for pinholes, voids and scratches.

Comparing runs 1, 2, 3 and 7 with runs 4, 5 and 6, it is apparent that employment of hydrolyzed copolymer according to the present invention permits the use of a lower platen temperature which in turn is probably responsible in large measure for the reduction in cupping achieved. Quite surprising was the finding that use of the hydrolyzed copolymer

increased yields from 2 to 7 fold. This was unexpected in view of the fact that Union Carbide literature states that coatings of its hydrolyzed copolymer have appreciably higher melting points than similar polyvinyl chloride-polyvinyl acetate films.

Run 7 reported in the table confirms that no satisfactory blanks were obtained when operating at the reduced platen temperature without the hydrolyzed copolymer.

#### WHAT WE CLAIM IS:—

1. A laminated article comprising a base of vinyl plastics as hereinbefore defined having a surface at least a portion of which is provided with a coating consisting of a dry residue of a partially hydrolyzed vinyl chloride-vinyl acetate copolymer comprising on a solids basis, from 88 to 94 weight percent polyvinyl chloride, from 2 to 6 weight percent

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- polyvinyl acetate, and from 2 to 10 weight percent polyvinyl alcohol and a magnetic impulse record element comprising a dispersion of magnetic particles in a binder matrix overlying and bonded to said coating. 5
2. An article as claimed in Claim 1 wherein the coating has a thickness in the range of 0.01 to 0.03 mil. 30
3. An article as claimed in Claim 1 or Claim 2, wherein the magnetic impulse record element is in the form of a stripe. 35
4. An article as claimed in Claim 3, wherein the width of the magnetic impulse record element is greater than 0.3 inches.
5. An article as claimed in any of Claims 1 to 4, wherein the amount of deformation of the base due to the transfer of the impulse record is less than 200 micro-inches per 0.1 inch of the record element width. 40
6. A method of providing on a base of vinyl plastics as hereinbefore defined a magnetic impulse record element, comprising the steps of:—
- forming on a backing strip a transferable magnetic impulse record element comprising a dispersion of magnetic particles to a binder matrix, forming on at least a portion of the base, or on the magnetic impulse record element, a coating, which is adhesive when hot, and which consists of a dry residue of a partially hydrolyzed vinyl chloride-vinyl acetate copolymer comprising, on a solids basis, from 88 to 94 weight percent polyvinyl chloride, from 2 to 6 weight percent polyvinyl acetate, and from 2 to 10 weight percent polyvinyl alcohol, and transferring the magnetic impulse record element from the backing strip to the base by a hot-stamping process, with the coating between the element and the base. 40

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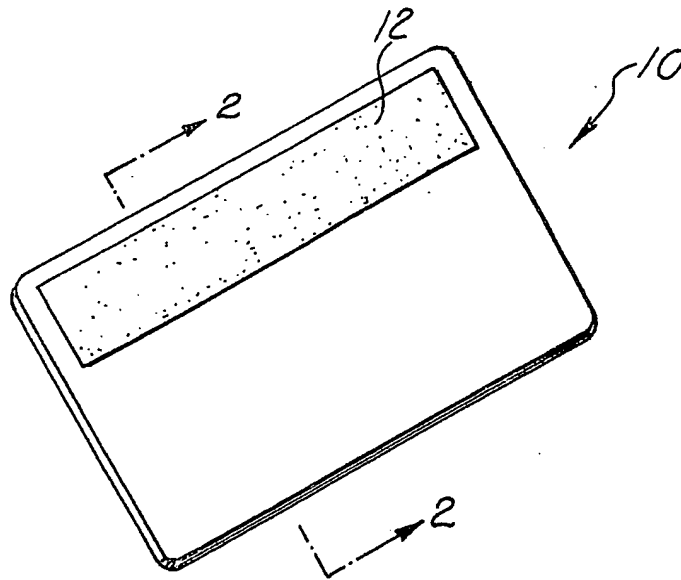


FIG. 1

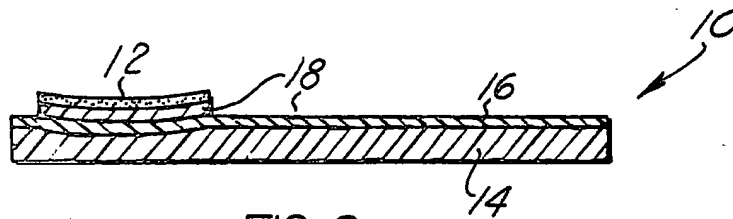


FIG. 2

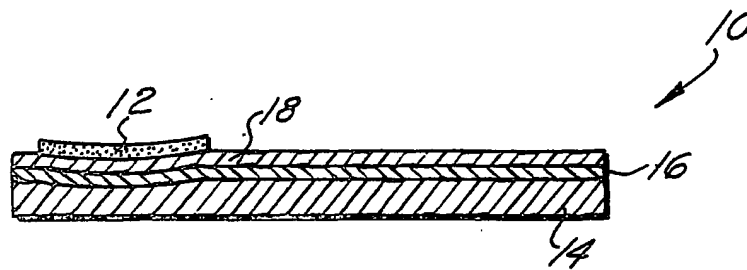


FIG. 3